ABSTRACT

Using MERRA Gridded Innovations for Quantifying Uncertainties in Analysis Fields and Diagnosing Observing System Inhomogeneities

Arlindo da Silva and Christopher Redder
NASA/Goddard Space Flight CenterGlobal Modeling and Assimilation Office, Greenbelt, Maryland 20771

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MERRA is a NASA reanalysis for the satellite era using a major new version of the Goddard Earth Observing System Data Assimilation System Version 5 (GEOS-5). The Project focuses on historical analyses of the hydrological cycle on a broad range of weather and climate time scales and places the NASA EOS suite of observations in a climate context. The characterization of uncertainty in reanalysis fields is a commonly requested feature by users of such data. While intercomparison with reference data sets is common practice for ascertaining the realism of the datasets, such studies typically are restricted to long term climatological statistics and seldom provide state dependent measures of the uncertainties involved.

In principle, variational data assimilation algorithms have the ability of producing error estimates for the analysis variables (typically surface pressure, winds, temperature, moisture and ozone) consistent with the assumed background and observation error statistics. However, these "perceived error estimates" are expensive to obtain and are limited by the somewhat simplistic errors assumed in the algorithm. The observation minus forecast residuals (innovations) by-product of any assimilation system constitutes a powerful tool for estimating the systematic and random errors in the analysis fields. Unfortunately, such data is usually not readily available with reanalysis products, often requiring the tedious decoding of large datasets and not so-user friendly file formats. With MERRA we have introduced a gridded version of the observations/innovations used in the assimilation process, using the same grid and data formats as the regular datasets. Such dataset empowers the user with the ability of conveniently performing observing system related analysis and error estimates. The scope of this dataset will be briefly described.

We will present a systematic analysis of MERRA innovation time series for the conventional observing system, including maximum-likelihood estimates of background and observation errors, as well as global bias estimates. Starting with the joint PDF of innovations and analysis increments at observation locations we propose a technique for diagnosing bias among the observing systems, and document how these contextual biases have evolved during the satellite era covered by MERRA.